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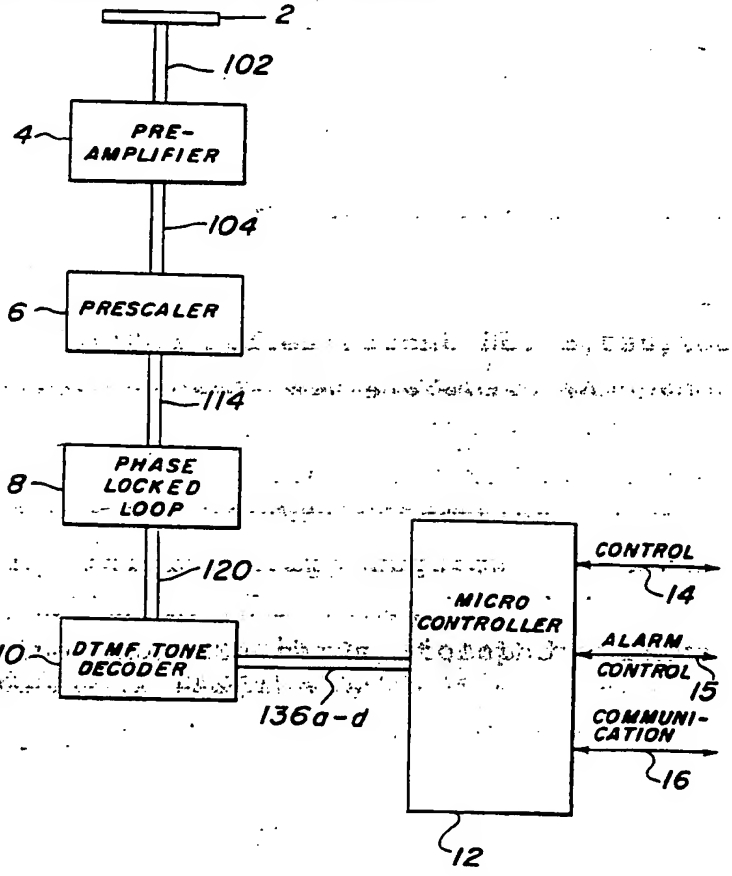
(54) Title: CELLULAR TELEPHONE ACCESS CONTROL AND IDENTIFICATION SYSTEM

(57) Abstract

A cellular telephone access control, identification, and intruder alarm activation and deactivation system (15) that uses transmitters which generate a dual tone, multi-frequency (DTMF) modulated signal. Thus, persons who have standard portable, cellular or mobile telephone can use the telephone to obtain access to controlled areas and/or to activate and deactivate home or commercial building alarm systems. A personal identification number is assigned to each user and the user merely dials in the number to obtain access or operate the alarm system. The system may be used to permit access to controlled areas such as garages, parking lots, office areas, roads and the like, and control (15) their alarm systems. It can also identify the person seeking entry and provide inputs to billing systems for parking lots, garages and toll roads. A remote control station may be used to provide centralized control for admittance to sensitive areas.



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CELLULAR TELEPHONE ACCESS CONTROL AND IDENTIFICATION SYSTEM

SPECIFICATION

FIELD OF THE INVENTION

The present invention relates to access control and identification systems and more particularly to an access control identification system wherein the person desiring access transmits a personal code using standard mobile, cellular or pocket size telephone (PCS) and personal communication network (PCN) terminals and other portable wireless communication devices transmitting dual tone, multi-frequency (DTMF) signals over carrier frequency, hereinafter referred to as "Communication Terminals".

BACKGROUND OF INVENTION

Various types of access control and identification systems are known and are presently in use including those wherein the person desiring access, or to be identified, uses telephones via telephone lines, transmitters, keyboards, magnetic cards and the like.

United States Patent No. 3,801,742 (O'Brien, et al.); and United States Patent No. 4,436,958 (Hansen, et al.) disclose the use of telephone lines for transmitting codes and signals to provide access.

United States Patent No. 3,701,100 (Yarbrough) discloses a badge reading system for allowing access. Access control using magnetic card devices are shown in United States Patent No. 3,750,828 (Constable). United States Patent No. 3,831,065 (Martin, et al.) discloses keyboard devices to unlock doors. United States Patent No. 5,086,298 (Katsu, et al.); United States Patent No. 4,868,915 (Anderson III, et al.); and United States Patent No. 4,973,958 (Hirano, et al.) disclose the use of coder transmitters to provide access to controlled areas.

Present access control systems require the person desiring access to use special devices or equipment intended for that purpose including magnetic cards, telephone lines, keyboard devices or coded transmitters.

None of the present systems use a standard type of equipment available for other purposes to the person requiring access, or the person to be identified, including communication terminals providing DTMF modulated signals such as standard cellular or mobile telephones. Nor do any of the present systems allow for the use of standard, cellular or mobile telephones to activate or deactivate home or commercial intruder alarm systems.

OBJECTS OF THE INVENTION

Accordingly, it is a general object of this invention to provide an access control, identification and alarm activation and deactivation system which receives and acts upon signals transmitted from communication terminals providing DTMF signals such as standard, portable mobile or cellular telephones.

It is a further object of this invention to provide an access control, identification and alarm activation and deactivation system which restricts access to those who use assigned, individual personal identification numbers.

It is yet a further object of this invention to provide an access control, identification and alarm activation and deactivation system which can automatically allow access to controlled areas and which can be used to identify the person desiring an access.

It is still yet a further object of this invention to provide an access control, identification and alarm activation and deactivation system wherein a controller, at a remote point can initiate access to controlled areas, after the person desiring access has been identified.

It is an additional object of this invention to provide an access control, identification and alarm activation and deactivation system which records the identity, date, time and location of entry of persons requesting entry.

It is yet an additional object of the invention to provide information for revenue and billing control systems

which use the assigned, individual personal identification numbers of the users.

It is still yet an additional object of this invention to provide an intruder or burglar alarm activation and deactivation system which receives and acts upon signals transmitted from standard cellular, portable, or mobile telephones.

SUMMARY OF THE INVENTION

These and other objects of this invention are achieved by providing an access control and identification system which receives and processes signals transmitted by the person desiring access using a standard communication terminal such as a portable, mobile or cellular telephone. The person desiring access enters a confidential and unique code into the keyboard of the telephone which modulates the carrier transmitted by the telephone. The signal is received by a directional antenna which feeds the information into receiving equipment and signal processing equipment. The signal processing equipment demodulates the received signal. A tone decoder provides (hexadecimal) digital information to a microcontroller. The microcontroller has previously stored therein the unique and confidential personal identification numbers of each of the users.

In the preferred embodiment, the personal identification number comprises six digits. A microcontroller then compares the incoming six digits to the numbers it has stored and if there is a correspondence, the microcontroller outputs a signal to release the access door, gate or barrier allowing access to the person or the person's vehicle into controlled areas.

Alternatively, the personal identification number can be transmitted to a central location where the identification of a person desiring access can be displayed. A controller at the central location can then, if the identification is proper, transmit a signal back to the microcontroller to operate the entry device. Thus, the system cannot only provide immediate entry, but can also

provide entry from a remote location. In addition, information is available as to which individuals have entered the facility, the date, time and location at which entry occurred.

It should also be noted that the system can be applied to other types of restricted access facilities, such as cash dispensing devices, locked vehicles, and the like.

In addition to providing access control and identification, the system can either alone, or in conjunction with access control and identification, provide for the activation or deactivation of home or commercial intruder alarm systems.

DESCRIPTION OF THE DRAWING

Other objects and many of the intended advantages of this invention will be readily appreciated when the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

Fig. 1 is an overall block diagram of the access control and identification system of this invention.

Fig. 2 is a detailed block diagram of the access control and identification system of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in greater detail to the various figures of the drawing wherein like references and characters refer to like parts, an overall block diagram of the instant invention is shown in Fig. 1. As will be described in detail below, the person desiring access to a controlled area uses the keyboard of a portable, mobile or cellular telephone to punch in a personal identification number, which is unique and confidential to the person. The telephone transmits the standard type of dual tone, multi-frequency (DTMF) modulated carrier signal which is used in cellular systems. The frequencies of the modulation tones are defined by the various keys of the telephone keypad.

If alarm system activation and deactivation is used in conjunction with access control, a second personal

identification number can be used to activate and deactivate the alarm system. If the alarm system activation and deactivation is used alone without automatic access control, a single personal identification number can be used.

Table 1 shows the various keys on the portable, mobile or cellular telephone and the two modulation frequencies generated when the key is depressed. For example, if digit number 1 of the telephone is depressed, the carrier frequency is modulated by a low frequency signal of 697 Hz and a high frequency signal of 1,209 Hz. As can be seen in Table 1, there are 4 low frequencies and 4 high frequencies used, which allow for 16 combinations representing each of 16 possible digits on the keypad.

TABLE 1.

DIGIT	LOW FREQ.Hz	HIGH FREQ.Hz	HEXADECIMAL CODE
1	697	1209	0001
2	697	1336	0010
3	697	1477	0011
4	770	1209	0100
5	770	1336	0101
6	770	1477	0110
7	852	1209	0111
8	852	1336	1000
9	852	1477	1001
0	941	1336	1011
*	941	1209	1010
#	941	1477	1100
A	697	1633	1101
B	770	1633	1110
C	852	1633	1111
D	941	1633	0000

Standard carrier frequencies are allocated to each country. For example, in the United States the transmit frequency for channel 1 starts at 825.03 MHz. and increases by 30 kHz. per channel. There are a total of 832 channels. The carrier frequency is frequency modulated by the dual tone, multi-frequency (DTMF) signal.

As shown in Fig. 1, antenna 2 receives the DTMF signal. Antenna 2 of the preferred embodiment is directional

in that it receives signals in greater amplitude from the front and back sides rather than from the left or right sides. In some applications, however, an antenna with 360 degrees of reception may be used.

The signal received from the antenna 2 is sent to preamplifier 4 by line 102. In this specification, the term "line" refers to one or more conductors which carry an electrical signal. Preamplifier 4 is a broad band preamplifier covering the range of cellular telephone transmissions of 800 mega Hz. to 1 gigahertz. Should other frequencies be allocated, by the FFC or other agencies, to the above mentioned communication terminals, the preferred embodiment frequency range will be adapted accordingly. The amplification enhances the signal over other radio frequency signal noise and transmissions. The output of the preamplifier 4 is sent to the prescaler 6 via line 104. The prescaler 6 successively divides the frequency of the input signal by half in three stages to produce at its output on line 114 a signal of one-eighth of the frequency of the original input carrier signal.

Phase lock loop circuitry 8 extracts the DTMF tones from the carrier frequency which have been previously divided by a ratio of 8. The output of the phase lock loop circuitry 8 on line 120 is connected to DTMF tone decoder 10 which converts the DTMF signals to binary signals of 4 bits and shown in Table 1 for each dialed digit. The 4 digital binary bits on lines 136 (a - d) are fed into a microcontroller 12.

For verification and identification the microcontroller 12 receives, in turn, 4 bit representations of each of the 6 digit personal identification numbers inserted by the person who desires entry, or to activate or deactivate an alarm system and compares the personal identification number to pre-stored numbers in the microcontroller for verification and identification. At this point, the system operates in various modes. In one mode, the microcontroller, on control line 14, outputs a signal which directly operates the entry device (a door, a gate, a barrier and the like). The control and communication lines are bi-directional so the control and communication signals flow from and to the system. In addition, the microcontroller can also be connected to other types of devices, such as money dispensing devices and vehicle locks.

In another mode, the microcontroller via communication lines 16 sends the personal identification number to a remote control area with a display and a processor where the number is displayed and information relating to the identity of the user can be called up. If verification is made, the central equipment sends a control signal back to the microcontroller on line 14 and/or 16 to then cause a microcontroller to output a signal to operate the entry device. The system is not only capable of permitting access upon proper verification, but also of identifying the person desiring entry and recording the identity, date, time and location at which the inquiry and entry occurred.

For activation or deactivation of the intruder alarm system, the microcontroller 12 sends a signal to the alarm system on alarm control line 15.

Referring now to Fig. 2 the transmitted signal from the mobile or cellular telephone after having been received by the antenna 2 and amplified by the preamplifier 4 is connected to a second amplifier 18 of the prescaler 6. Within the dashed lines of Fig. 2, are the components of each of the blocks of Fig. 1. The output of the amplifier 18 on line 106 is connected to divider 20 which divides the frequency of the signal by two. Divider 22 also divides the frequency by two so that appearing on line 110 is a signal of one quarter of the frequency of the incoming carrier signal. Divider 24 again divides the signal by two so that its output on line 112 is one eighth of the input carrier signal. This signal is buffered by buffer 26 and connected to phase detector 28 of the phase lock loop circuitry 8 by line 114.

The output of the phase detector 28 is connected by line 116 to the input of filter 30 which filters the signal which is sent to voltage control oscillator 32 on line 118. The voltage control oscillator 32 will change its frequency until its output voltage eo on line 120 is equal to the voltage ei at the input of the phase detector 28 until the phase loop is locked. Any change in the input voltage ei to the phase detector 28 will be tracked by the voltage control oscillator 32, and its output voltage eo back to the phase detector 28 will be changed so that it continues to follow the changes in input voltage.

The output of the voltage control oscillator 32 comprises the modulation signal originally applied to the carrier. It is connected to buffer 33 by line 120. The output of buffer 33 on line 121 is connected to preprocessor 34 of the DTMF tone decoder 10. The preprocessor 34 controls the level of the input signal on line 22 to the band splitter 36 which separates the high and low modulation frequencies on lines 124 and 126, respectively, and connects them to high and low band filters 38 and 40 respectively. The outputs of high and low band filters 38 and 40 on lines 130 and 132, respectively, are connected to timing and decoding circuitry 42 which determines the higher and lower frequencies and outputs the appropriate hexadecimal code via lines 134 a, b, c and d to an output register 44. The output of register 44, on lines 136 a, b, c and d are sent to the microcontroller 12.

As stated previously, the six digits keyed in at the cellular or mobile telephone are received in turn by the microcontroller 12 and compared to previously stored codes or sent to other computers for further processing via communication links.

To store the valid codes, the microcontroller 12 is set into a programming mode by a switch. A sequence of digits may then be entered via cellular or mobile telephone or a keypad connected to the microcontroller 12 for entry of codes.

When the microcontroller 12 is connected to other controllers or computers via a communication link as shown in

Fig. 1, it operates in the on-line mode. The communication link can be a standard RS 232, RS 422, or Weigand serial communication link, or any other link used commonly in the data communications industry.

Similarly, the remainder of the system can be made up of standard off-the-shelf chips and circuits. The preamplifier 4 can be an NEC, UPC1688G amplifier or equivalent; the prescaler can be provided by the NEC UPB58G or equivalent; the phase lock loop circuitry 8 can be provided by the Signetics NE586 or equivalent; and the DTMF tone decoder can be the Telltone M-957-01 DTMF receiver or equivalent.

An access control and identification system has been described which uses standard, portable cellular and mobile telephones for the entry of personal identification codes to allow access to controlled areas, to provide identification of personnel, and/or to activate or deactivate intruder alarm systems. The system can be used directly from automobiles to provide access to controlled parking areas and controlled roads. Also, mobile telephones can be used by persons desiring access to rooms, internal controlled areas, or the activation and deactivation of alarm systems. Furthermore, as previously mentioned, the system can be used to provide various other functions such as to operate cash dispensing machines, lighting systems, door locks on vehicles, and the like.

Without further elaboration, the foregoing will fully illustrate my invention so that others may by applying

current or future knowledge, readily adapt the same for use under the various conditions of service.

CLAIMS

What is claimed as the invention is:

1. A system providing access control to a secure area comprising a mobile transmitter, a receiver, a decoder, a microcontroller and a means for providing entry into said secure area, said system being characterized by said transmitter generating and transmitting a dual tone, multi-frequency (DTMF) modulated carrier signal and said receiver receiving said carrier signal directly from said transmitter, said system being fully operable without use of, or communication with or through a public or private external telephone switching network.

2. The system of Claim 1 characterized in that said mobile transmitter comprises a standard, commercial cellular telephone.

3. The system of Claim 1 characterized in that said mobile transmitter comprises a standard, commercial mobile telephone.

4. The system of Claim 1 characterized in that said mobile transmitter comprises a standard, commercial personal communication service (PCS) telephone.

5. The system of Claim 1 characterized in that said mobile transmitter comprises a personal communication network (PCN) device.

6. The system of Claim 1 characterized in that said decoder provides a decoded signal to said microcontroller and said microcontroller comprises a comparator which compares said decoded signals to pre-stored codes and means for operating said means for providing entry when said decoded signals corresponds to one of said pre-stored codes.

7. The system of Claim 6 characterized in that said system further comprises a remote facility and means to transmit said decoded signal to said remote facility.

8. The system of Claim 7 characterized in that said remote facility comprises a display, a storage means, a processor and means to transmit a central signal to said processor.

9. A system for operating an intruder alarm system for a secure area comprising a mobile transmitter, a receiver a decoder a microcontroller said system being characterized by said transmitter generating and transmitting a dual-tone, multi-frequency (DTMF) modulated carrier signal and said receiver receiving said carrier signal directly from said transmitter, said system being fully operable without use of, or communication with or through a public or private external telephone switching network.

10. The system of Claim 9 characterized in that said mobile transmitter comprises a standard, commercial cellular telephone.

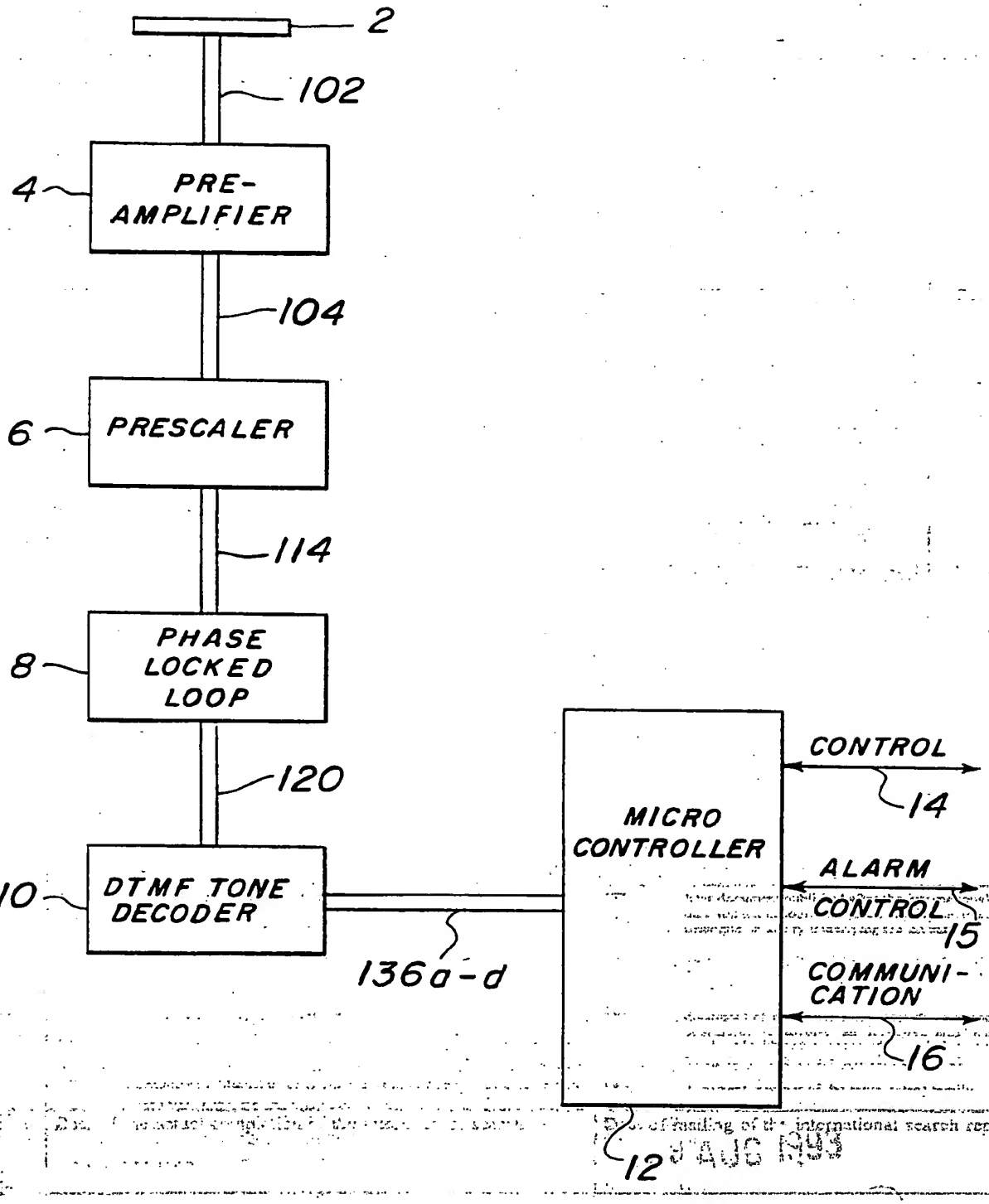
11. The system of Claim 9 characterized in that said mobile transmitter comprises a standard, commercial cellular telephone.

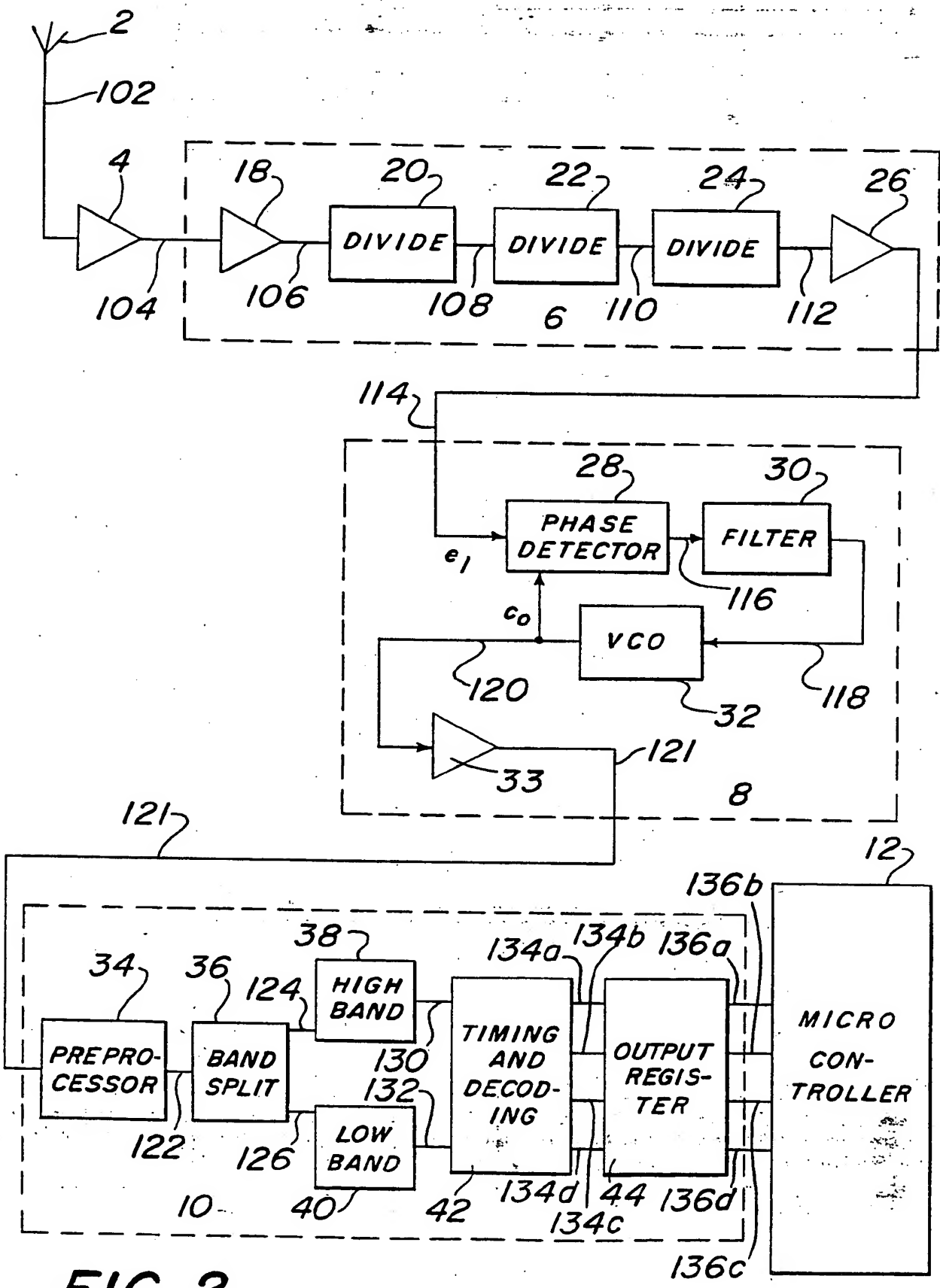
12. The system of Claim 9 characterized in that said mobile transmitter comprises a standard, commercial personal communication service (PCS) telephone.

13. The system of Claim 9 characterized in that said mobile transmitter comprises a personal communication network (PCN) device.

14. The system of Claim 9 characterized in that said decoder provides a decoded signal to said microcontroller and said microcontroller comprises a comparator which compares said decoded signals to pre-stored codes and means for activating and deactivating said intruder alarm system.

FIG. 1

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PHASE DETECTOR
FILTER
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c_o
VCO
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118
32
121
33
8
121
12
136b
38
134a
134b
136a
34
36
124
HIGH BAND
PREPRO-CESSOR
BAND SPLIT
130
TIMING AND DECOD-ING
OUTPUT REGIS-TER
MICRO CON-TROLLER
132
122
126
LOW BAND
10
40
42
134d
44
136d
134c
136c

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/06272

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04M 11/00
US CL :379/58

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 379/58, 59, 63, 91, 103, 105, 111

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US, A, 4,882,746 (SHIMADA) 21 November 1989, see col. 1, lines 52-68; col. 13, lines 55-62; and col. 14, lines 47-53	1,6 2-5, 7-14
Y,P	US, A, 5,138,649 (KRISBERGH et al.) 11 August 1992, see whole document	1-14
Y	JP, A, 1-180136 (SHIGA) 18 July 1989 see abstract	1-14
Y	US, A, 4,338,493 (STENHUIS et al.) 06 July 1982, see col 2, lines 5-16	7, 8
A	US, A, 4,023,139 (SAMBURG) 10 May 1977, see abstract	1-14

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US, A, 4,578,540 (BORG et al.) 25 March 1986, see abstract	1-14